CONVENTION ON LONG-RANGE TRANSBOUNDARY AIR POLLUTION

International Co-operative Programme
on
Effects on Materials, including Historic and Cultural Monuments

Minutes of the 23rd Meeting of the Programme Task Force

12-13 March 2007, Centre de Recherche des Musées de France, Louvre Palace, Paris

Prepared by the Main Research Centre
Corrosion and Metals Research Institute, Sweden

Participants: Stephan Doytchinov, *co-chair* - Italy
Vladimir Kucera, *acting co-chair* - Sweden
Heinz Gregor, *WGE vice chair* - Germany
Manfred Schreiner - Austria
Katerina Kreislová, Milos Drdácký , Zuzana Slízková - Czech Republic
Ott Roots - Estonia
Anne Chabas , Anda Ionescu , Roger-Alexandre Lefèvre, Tiziana Lombardo - France
Stefan Brueggerhofer, Stephan Fitz , Thomas Gauger - Germany
Augusto Screpanti - Italy
Terje Grøntoft, Jan Henriksen (part of the meeting) - Norway
Daniel de la Fuente, Jesus M. Vega - Spain,
Lena Sjögren - Sweden
Daniel Reiss - Switzerland
Ron Hamilton, John Watt (part of the meeting), Tim Yates - United Kingdom

Sent to: Above and
Dagmar Knotkova - Czech Republic, Johan Tidblad, *co-chair* - Sweden, Jean-Jacques Hechler – Canada, Nicola Shoylev – Bulgaria, Stefan Simon – Germany, Marcus Faller - Switzerland

1. Opening of the meeting

As co-chairman of ICP Materials, *Stephan Doytchinov* thanked LISA for organizing the meeting and declared the meeting opened.

2. Approval of Draft Agenda

The draft agenda was approved.

3. Introduction

Vladimir Kucera introduced the meeting pointing out the most important topics of the week:

- the combined workshop with ICP Materials and CULT-STRAT
- presentations of new corrosion and soiling results from the trend exposure

- discussions of the revision of the Mapping Manual
- reporting of ICP Materials to the Working Group on Effects – 2007 and 2008 work plans

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4. Information from WGE

Heinz Gregor, the vice chairman of WGE, presented information from WGE and information from the secretariat in Geneva obtained from Matti Johansson.

Albania and Macedonia have joined the convention, now signed by 51 parties.

The Protocols in force are
– 1985 and 1994 Sulphur Protocols
– 1988 NOx Protocol
– 1991 VOC Protocol
– *1998 Heavy Metals Protocol*
– *1998 POP Protocol*
– *1999 Gothenburg Protocol*

The Protocols reflect a stepwise increased ambition level. Protocols in *italics* are being reviewed. The 1999 Gothenburg Protocol has just come into force last year. It will be revised shortly, not all pollutants are covered, particulate matter will probably be included in the revised version. A report from the revision group is expected this summer.

Heinz Gregor has resigned as chairman of the Working Group on Effects, but has volunteered to continue to act as vice chairman. The new chairman is Mr. Tor Johannessen. The main tasks resulting from the last meetings of WGE and of the Executive Body of the Convention are presented in Fig1.

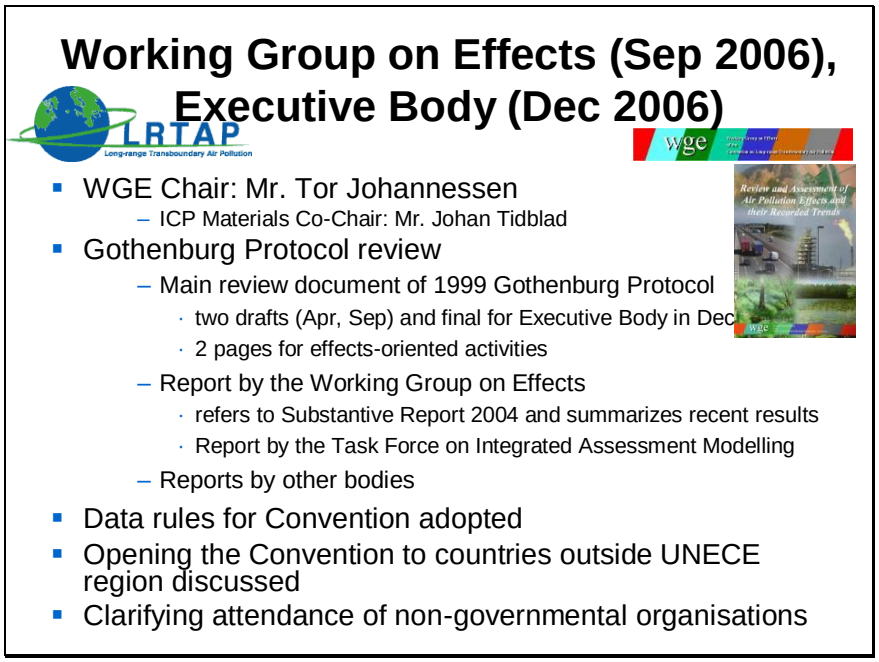

Figure 1. Recent news and main present tasks of the Convention and the WGE.

Workplan items common to all programmes which constitute a part of the implementation of long-term strategy:

1. Effects-based approaches for the review of protocols for Gothenburg Protocol
2. Dose-response functions and potential stock at risk mainly from programme's monitoring
3. Links between field observations and critical loads/levels, "evidence" reporting

4. Robustness of monitored and modelled air pollution impacts, quantitative or qualitative information for integrated modelling
5. Observed and new parameters, monitoring methodologies and temporal/spatial intensities
6. Effects-oriented activities in countries of Eastern Europe, Caucasus and Central Asia

Signing the convention involves the obligation to follow the convention that is to reduce emissions and monitor effects – without any funding. This would be a problem for item 6 involving countries with poor economy. There are discussions on funding, from other parties, for getting these countries started.

Vladimir Kucera pointed out that the next trend exposure will start in the autumn of 2008, this would be a good opportunity to extend the exposure programme including countries mentioned under item 6 above. The new programme will be decided in July 2007. Participants having partners in this region are encouraged to bring forward requests in April 2007 for funding these partners.

Reports from the ICP Materials task force to WGE shall i.a. include information on work planned in 2007 and the Technical report

With his presentation, *Heinz Gregor* gave his official goodbye to the group. *Vladimir Kucera* expressed his thanks to Heinz for his contribution to this meeting and to all support during the years.

5. Report and discussion of results from the new ICP Materials trend exposure

Vladimir Kucera reports that withdrawal of specimens has been performed after one year exposure, in the fall of 2006. For these specimens, raw data exist but the data have not yet been analysed. The results are presented by the individual sub-centres in the following. For reference, numbering of the test stations is shown in Fig 2.

No	Name	Country		No	Name	Country
1	Prague-Letnany	Czech Republic		31	Madrid	Spain
3	Kopisty	Czech Republic		33	Toledo	Spain
10	Bottrop	Germany		35	Lahemaa	Estonia
13	Rome	Italy		37	Dorset	Canada
14	Casaccia	Italy		40	Paris	France
15	Milan	Italy		41	Berlin	Germany
16	Venice	Italy		44	Svanvik	Norway
21	Oslo	Norway		45	Chaumont	Switzerland
23	Birkenes	Norway		50	Katowice	Poland
24	Stockholm	Sweden		51	Athens	Greece
26	Aspvreten	Sweden		52	Riga	Latvia
27	Lincoln Cathedral	United Kingdom		53	Vienna	Austria

Figure 2. ICP Materials test stations

5a) Environmental data obtained from national contact persons

5b) Environmental data: results from passive sampling by IVL

Terje Grøntoft reports from the environmental sub-centre NILU showing availability of data from different stations. Data are still lacking from several sites. Since the technical report to WGE will include environmental data, the data is needed before the end of March, pollution data being of primary interest.

Terje Grøntoft presented some of the new data:

4-5 stations still have high SO_2 concentrations showing that SO_2 is still a problem at hot spots.

Spread in concentrations of NO_2 is smaller, although Athens, Katowice and Paris are still high among the urban stations. Concentrations are low at the rural sites.

For O_3 there are large differences between low and high sites. High concentrations have been measured in Toledo and Chaumont. The high concentrations obtained for Svanvik may be due to the vicinity of the Nikel region in Russia. For a few sites, there are results from both monitoring and from IVL passive samplers, IVL data are generally lower.

At most sites, particle deposition is smaller under sheltered conditions, the difference being very high at Athens, while the same deposition has been obtained in Katowice. *Tiziana Lombardo* needs PM_{10} data for soiling dose-response functions. These data are available for four stations only (not mandatory). *Tiziana Lombardo* asked about possibilities to transfer particulate flux data, deposition rate, to concentration of particles, the latter required for the dose-response functions. *Vladimir Kucera* reminded that conversion equations have been derived in the MULTI-ASSESS project. The usefulness of such equations was discussed. IVL (Martin Ferm) should have PM_{10} data for a couple of sites, possibly eight.

HNO_3-concentrations show an even distribution between sites. High concentrations have been obtained for Madrid (not for other gases though), Athens, Paris, Prague and Katovice. Rural sites show low concentrations. Stockholm concentrations are comparatively high while one of the lowest has been obtained for Aspvreten. *Vladimir Kucera* pointed out that HNO_3 is about 20 times as corrosive as SO_2, something that must be taken into account when evaluating importance of the different pollutants.

5c) Corrosion of carbon steel

Katerina Kreislova presented carbon steel corrosion data; unfortunately some specimens were lost in the mail. A draft report no 53 was distributed. SO_2-concentrations are found to increase again in the Czech countryside, explained by increased gas and electricity prices resulting in coal being used again for domestic heating. In cities, where possibilities to return to coal heating are limited, this effect is not seen.

5d) Corrosion of zinc

Daniel Reiss presented zinc corrosion data. Some stations show an increasing trend as Kopisty where the SO_2 level has increased. If excluding the northern and high altitude sites, stable corrosion rate are obtained. The northern and high altitude sites: Norway, Sweden and Chaumont, show increased corrosion rate. The so called “memory effect” caused by wet conditions during the first few exposure weeks, stressing surfaces, was one explanation suggested. Presence of snow may also have had an effect. Several of the stations are above the tolerable corrosion level. The reason of this effect and ways to investigate it were discussed. One possibility is to include in the next trend exposure starting in 2008 zinc specimens for 1, 2 and 4 years exposure in order to determine if the increased corrosion rate will persist also for longer exposure periods than 1 year.

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5e) Corrosion of limestone

Tim Yates presented Portland limestone trend data showing generally increased recession rate and an additional increase at more or less the same sites as those showing increased zinc corrosion. There are however still some gaps and some checks required. Stones for the last series, showing increased recession rate, was from a new set from the same quarry, the specimens may thus not be identical to the previously exposed ones. Comparisons between the two sets of stone will be made and a possibility to use a correction factor will be investigated.

5f) Soiling of modern glass

Tiziana Lombardo presented results from exposure of silica-soda lime glass, normal window glass, evaluated gravimetrically and optically for soiling. Results from one year sheltered exposure at 23 sites are available. The optical evaluation is based on haze measurements, integrated over a range of visible light. Haze is a parameter used by the glass industry. Fresh glass sheet have 0,2-0,3 % haze depending on thickness, 1% is considered poor

Mass gain results from the IVL passive Teflon samplers have been compared with glass haze results, showing correlation between the two for most stations, except Katowice, Chaumont, Berlin, and Kopisty. In this comparison differences between the environment types was noted: low haze and low mass loss for rural sites, higher haze and mass loss for urban traffic sites. There is not necessarily a correlation between haze and mass gain since haze is related to the chemical composition of particles and not to the amount. Further, large, heavy particles do not scatter light and particles that are not black will not absorb light.

For the one year soiling trend, a correlation could be seen with PM_{10} annual average and with relative humidity. A theory brought forward was deposition of sulphate formed from SO_2. No correlation could be seen for NO_2, indicating no chemical reaction with NO_2. For some stations fungus could have contributed.

Dose-response functions are presently being developed. The soiling time relationship was shown to start slowly, then increase and decrease again, inflexion point after about 11 months.

For the dose-response functions, *Anda Ionescu* suggested multivariant statistics to see which variables to use. *John Watt* pointed out that, since there is always a mixture of particles and that the particle set is different for different environments, the same dose-response function cannot be expected for all environments. He suggested deriving an average function and adding comments.

5g) Soiling of Teflon filters

Terje Grøntoft presented soiling measured as reflection change on the IVL passive sensors, see Figure 3.

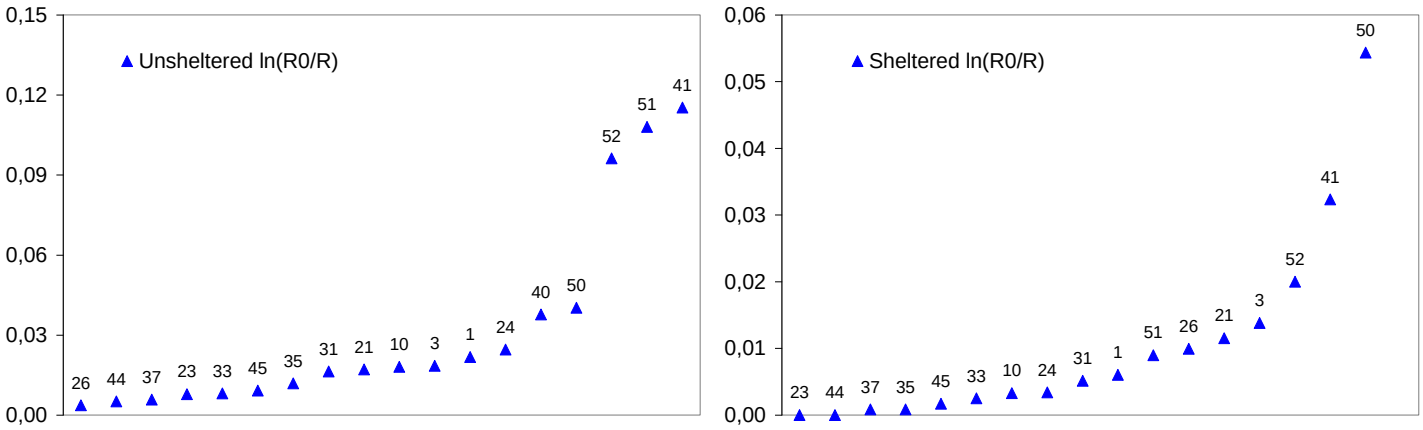

Figure 3. Unsheltered (shelter from rain) and sheltered (from rain and wind) exposure of Teflon filters, evaluated as reflection change

The Berlin station show very high loss of reflectance, comparatively higher as compared to change in haze for modern glass (5f). Both substrates and evaluation method (both optical though) differ.

Different results are to be expected for different materials. *Daniel Reiss* expressed the need for a soiling parameter to be linked to other parameters. Teflon has previously been found to be reliable, so is glass. It was found too early to decide what parameter to use.

Tiziana Lombardo promised to plot haze data vs. Teflon reflectance data (comparisons to be included in the CULT-STRAT deliverable17). *Vladimir Kucera* suggested more thorough analyses of chemical composition. For the glass specimens, only ions are analysed. Daniel Reiss will try and find out what parameters can be correlated.

General comments on trend exposures

ICP Materials has to develop methodology and plan for a new exposure program in order to clarify the unexpected results. Use of pre-corroded zinc specimens and comparing stone specimens from the new and old set as well was suggested. It was further suggested to perform 2 and 4 year exposures in order to see if the increase seen is just due to differences during the initial phase.

Methodology for soiling must further be developed: different substrates, methods, exposure duration. *Tim Yates* and *Tiziana Lombardo* will discuss suitable substrates: Some kind of homogenous stone could be included. With stone, more biological growth as compared to glass should be expected, especially for porous stone and prolonged exposure.

6. Planning of extension of the network

Stephan Doytchinov reports that a new exposure station at Sofia is now operating. The station is supported by the ministry of environment. Stephan Doytchinov will send an official request to obtain data from the station. The Israeli station can presently not participate, due to the complicated conditions in the country.

Manfred Schreiner informed that he has obtained financial support from the environmental authorities in Austria and the city of Vienna has offered a place for an exposure station in a residential area, where environmental data are measured. A site with heavy traffic would be preferable but all sites with heavy traffic entail many people, thus risk for vandalism. Glass, steel and stone samples have been received. The steel specimens can be used if visibly uncorroded. Suitable starting date for the exposure was discussed. *Tim Yates* will have the possibility to start exposure again on the Lincoln site in 2007 or 2008. If starting this year, exposure of stones for comparing the old and new sets can be performed Recommended starting date for both stations was agreed to be September or October 2007.

Vladimir Kucera informed about performing mapping of corrosion and soiling in Katmandu – 10 sites, within the RAPIDC/Corrosion programme. The one-year exposures started in October 2006, including all materials and environmental parameters used in the ICP Materials trend exposures. Results obtained will be available to ICP Materials. Additionally, one, two and four year results from 16 Asian and African sites will be available shortly.

Vladimir Kucera brought up the need to start planning for 2008. More funding than earlier years will be required due to the extended programme suggested, with longer exposure periods justified by the "strange" results reported above, possibly being due to climatic change.

7. Revision of ICP Materials contribution to the Mapping Manual

Unfortunately neither Stefan Fitz nor Heinz Gregor was present during this point. *Thomas Gauger* informed about the meeting of ICP Modelling and Mapping to be held on 21-27 April 2007 in Sofia. On the agenda is a report from ICP Materials on progress on the update of the mapping manual. It was decided that *Stephan Doytchinov* shall represent ICP Materials in the Sofia meeting, presenting a selection of our mapping results and reporting to the mapping group about the new dose-response functions and our ongoing work for revision of the materials chapter of the Mapping Manual. The meeting considered it important also to show the possibilities to map corrosion on different geographical scales from international to local. . *Thomas Gauger* suggested that a statement on soiling should be given for inclusion in the minutes of the Sofia meeting

Discussions on the ECE Mapping Manual

Vladimir Kucera made a short presentation of some topics to be taken into account in the revision of the mapping manual. It is proposed to include both SO_2 dominated and multi-pollutant functions and to give instructions for their choice and use. There should be uniformity in units, μm suggested for all material corrosion. After discussions, it was considered too early to include soiling at this time in the revision. Since electronic updates, with e-mail notification, are easy, they can be done continuously. *Vladimir Kucera* stated that, since the Mapping Manual is used also by others, e.g. in Asia, it should be up-to-date. There is however no needing not give the final version in Sofia.

Possible use of a universal legend was discussed: universal colours for corrosion rate or exceedance or optional use of colours. A universal legend proposed by *Johan Tidblad* was presented by *Vladimir Kucera*. It includes 9 intervals and colours for exceedances. The intervals for higher corrosivity are based on the ISO 9223 system, see Table 1.

Table 1. Universal legend for corrosion mapping (proposed by KIMAB). The RGB colour system is used. To ensure that the colours, when printed in black and white or copied, should be comparable to the grey scale the following empirical formula can be used: Grey = 0.299 x Red + 0.587 x Green + 0.114 x Blue

Interval number	Interval short name	Strategy for determination of corrosion interval	RGB	Grey
1	Background	n < 1,0	225-225-225	225
2	Very low	n between 1,0 and 1,5	193-193-255	200
3	Low	n between 1,5 and 2,0	0-250-250	175
4	Tolerable	n between 2,0 and 2,5	0-255-0	150
5	Medium	n = 2,5 to average between n=2,5 and low end of C4	255-83-0	125
6	Medium high	average between n=2,5 and low end of C3 to low end of C4	242-0-242	100
7	High	ISO 9223 Corrosivity category C4	251-0-0	75
8	Very high	ISO 9223 Corrosivity category C5	100-34-0	50
9	Extreme	ISO 9223 Corrosivity category CX but without an upper limit	25-25-25	25

The legend was discussed extensively. Guidelines were considered useful but the colour scheme proposed was considered to have too large steps to be useful for maps. It was further pointed out that the mapping community is more used to digital data, colours only for presentations, any colours can thus be used. This does not hold true, however, for our intended audience, policy makers need easily understandable information, with the same colour for the same risk. It was decided that we should have recommended classes and recommended colours for exceedance. If it is not sufficiently detailed, there is a possibility and freedom to subdivide the classes and use the colour for the class in several nuances (experts in presentations, printers etc. should be able to give advice concerning readability). KIMAB will further develop the legend.

Recommended grids were discussed. It was decided to recommend 5x5km as basis and to encourage the use of smaller grids, 1x1km, maybe even 100x100m, if information is available, making it possible to find corrosion hot spots.

Heinz Gregor suggested linking our mapping activities to mapping activities performed by other parties.

8. Information and co-planning of activities with the EU 6FP project CULT-STRAT: UNECE Workshop in Paris, 15-16 March, 2007

These activities have been planned during the CULT-STRAT meeting this week, the final planning will be performed led by *Ron Hamilton* and *Jan Henriksen* after the end of this meeting.

9. Documentation from Workshop "Economic Impacts of Air Pollution on Cultural Heritage"

Information from the previous workshop, including PowerPoint presentations, can be found at http://www.diseae.unict.it/envalab/en/downloads.aspx. The workshop report has been included in the 2006 technical report of ICP Materials.

10. Report from the sub-centre for stock-at-risk and cultural heritage in Italy – presentations of work on stock-at-risk and mapping by other members of ICP Materials.

Stephan Doytchinov presented results from ENEA. The European map with locations of UNESCO World Heritage Monuments, Italian maps with CH sites, Norwegian maps with stone buildings before 1650 and a map of Czech castle sites were shown overlapped with corrosion maps: limestone, sandstone, copper, cast bronze, comparing two different years were shown illustrating the usefulness of maps. All maps show decreased corrosion rate but in many cases were cultural heritage objects still in areas with exceedances.

Further, corrosion maps, comparing the ICP Materials and MULTI-ASSESS dose-response functions were presented, showing large differences. The functions are not supposed to be exchangeable but should be selected depending on prevailing conditions. *Heinz Gregor* would like to see modelled results to be validated by monitoring. *Stephan Doytchinov* pointed out that measurement results are available only at specific positions.

11. Reporting from ICP Materials to the Working Group on Effects

For the Working Group on Effects several documents are required:

Everything in the work plan for 2006 was found to be accomplished.

The work plan for 2007 was discussed:

- Corrosion maps for selected materials for Italy, Switzerland and Germany for 2005 (ENEA+UBA). There are further plans to merge Switzerland to the Lombardia region (ENEA+UBA). Parts of CULT-STRAT deliverable 15 can be used for the report. Responsible ENEA.
- Corrosion maps for selected materials at different spatial resolutions for Germany and Czech Republic. High resolution exceedance map for Italy and Switzerland using the RAINS model map could be included. Parts of CULT-STRAT deliverable 15 can be used for the report. Responsible ENEA.
- Report on areas of increased risk for corrosion at the urban level and on a case study on the stock of cultural heritage materials at risk (LISA). The first part of this is the limestone corrosion maps (Stephan Fitz) for 1990 and 2000 which should be included. For 2007 the task is changed to include only the case study. “Case study on the stock of cultural heritage materials at risk in Paris”. The same case study as supplied to John Watt for the reference manual. Responsible LISA and KIMAB.
- Report on recent results on corrosion at new material exposure sites: To include environmental data (NILU) and corrosion data (SVUOM, EMPA, BRE). possible effects of the new set of Portland Limestone (BRE) Responsible: KIMAB
- Paris workshop report (KIMAB+MU). Responsible KIMAB.
- Minutes of the 23rd meeting of the Programme Task Force. Responsible: KIMAB.

The tentative work plan for 2008 was discussed:

- Report on combined effects of global climate change and air pollution on cultural heritage. Done by KIMAB+NILU.
- Report on trends of corrosion and pollution (1987-2006). Done by KIMAB+BRE+SVUOM+EMPA.

- Mapping for Europe (Run-off for zinc on an EMEP scale). Done by KIMAB+ENEA+EMPA
- Stock at risk study for Madrid, possibly combined with corrosion maps. Done by CSIC.

12. Short, Medium and long-term plan for ICP Materials

There is a need to find out reasons for the anomalies found in the trend exposure 2006-07. For the next trend exposure longer exposure periods are required (1-4 years). Soiling should be included in the next four-year programme

13. Financing of the Programme

Several participants have problems with funding the work. Everyone is urged to try to get support from national funding sources. Personal engagement is very important. Since materials issues are often not of prime interest, these activities have to be linked to other activities. Otherwise there is a risk that the sites will cease to exist.

Everyone will have to clarify which ministry or other authority is responsible for the individual programme. This may also be ministries/authorities dealing with monuments, buildings etc. The national representative in WGE should be contacted for advice.

14. Extension of the time schedule

As mentioned in paragraph 12, longer exposure periods in the trend exposure, four years, are required.

15. Any other business

Tiziana Lombardo inquires for possibilities to make PM_{10} measurements mandatory but no such possibilities are foreseen. She also reminded that raw data for soiling etc. are required at the end of this month.

16. Next meeting

The 24th task force meeting will be held in Tallinn, 2-4 April 2008 (subject to confirmation).

17. Closure of the meeting

Vladimir Kucera declared the meeting closed, thanking the participants and LISA for their hospitality and a well organized meeting.